LEAF – REPLICA: A SENSOR FOR MEASURING LEAF BOUNDARY LAYER CONDUCTANCE

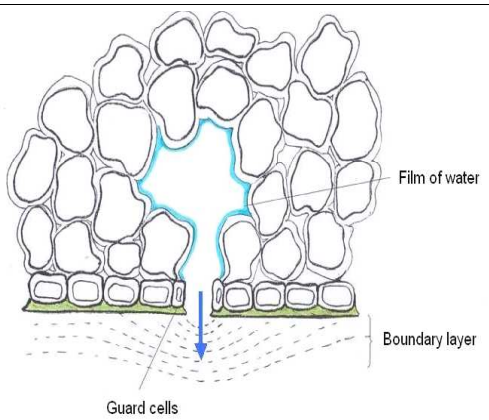


Figure 1

The boundary layer (bl) is a region of the flux next to the solid that is dominated by the shearing stresses originating at the surface of the solid (Nobel P.S. 2005); such layers arise for any solid immersed in a fluid, as a leaf in air (**figure 1**). Wind speed affects the thickness of the boundary layer next to a leaf (figure 2)

This parameter (bl) is affected by factors that influence aerodynamic characteristics of leaves (**figure 2**) such as leaf shape and structural characteristics of field or orchard. In particular it is strictly correlated to structural characteristics that can influence leaf aerodynamic interaction with the surrounding air: density of plantation, presence of windbreaks, height of plants, wind speed and direction, training system and planting system.

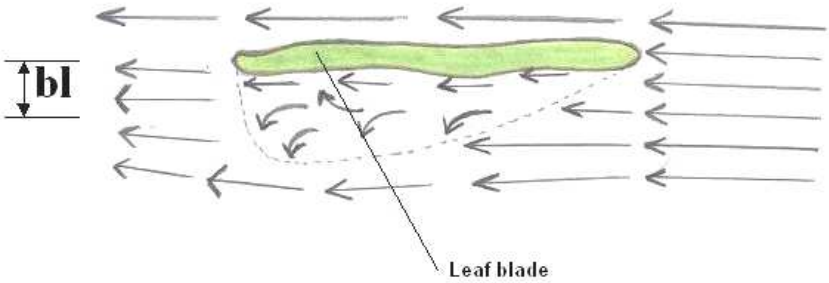
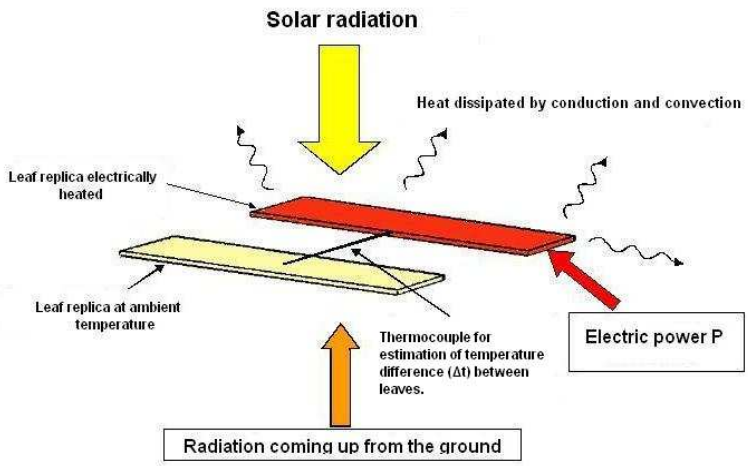


Figure 2



$$g_{bl} = f\,(P/\Delta t)$$

Figure 3

In gas exchange studies at leaf or whole plant level, the rule of g_{bl} (leaf boundary layer conductance) is often underrated and neglected: r_{bl} (boundary layer resistance that is the inverse of g_{bl}) is the last resistance in the pathway of water moving from soil through the plant to the atmosphere (Soil-Plant-Atmosphere Continuum - SPAC).

This sensor (leaf – replica) utilizes the method of Brenner A.J. and Jarvis P.G. (1995), that it was successively used by Pernice *et al.* (2003) and Motisi *et al.* (2007) in peach trees for ecophysiological studies. It uses a pair of copper leaves replica (one of these electrically heated), for the estimation of leaf energetic balance (**figure 3**).

Both leaves of sensor (leaf-replica) receive equal radiation from the surrounding air: difference of temperature (Δt) between them will be function of electric power (P) alternatively applied at both leaves (**figure 4**). Leaf boundary layer conductance will be correlated with P/Δt ratio.

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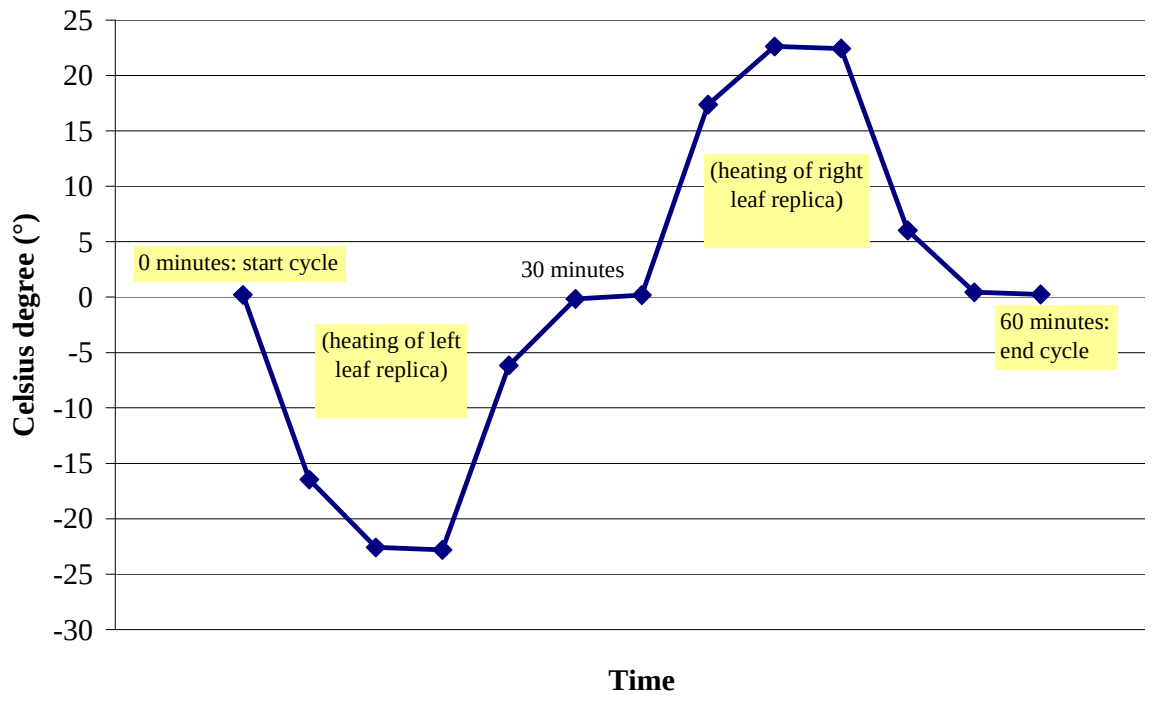

Figure 4

GMRStrumenti offers a complete system that can be easily connected to a datalogger. The system is made by the Leaf - Replica sensors, a control unit connected to a datalogger and an external Power supply (12 to 30 volts).
Up to 16 sensors can be connected to a single control unit, we can offer different sensors sizes and shapes to match properly the plant species you're studying.
The complete system is easy to set up and use as we also supply a software for easy post data processing.
If you're working with a Campbell datalogger we can also supply the programming instructions.

- **MULTICHANNEL SYSTEM UP TO 16 SENSORS TO A SINGLE CONTROL UNIT**
- **EASY TO USE**
- **SMART CONTROL UNIT**
- **EXTERNAL POWER SUPPLY 12/30 VOLTS**
- **DIFFERENT SIZES AND SHAPES TO MATCH DIFFERENT PLANT SPECIES**
- **POST DATA PROCESSING SOFTWARE AVAILABLE**
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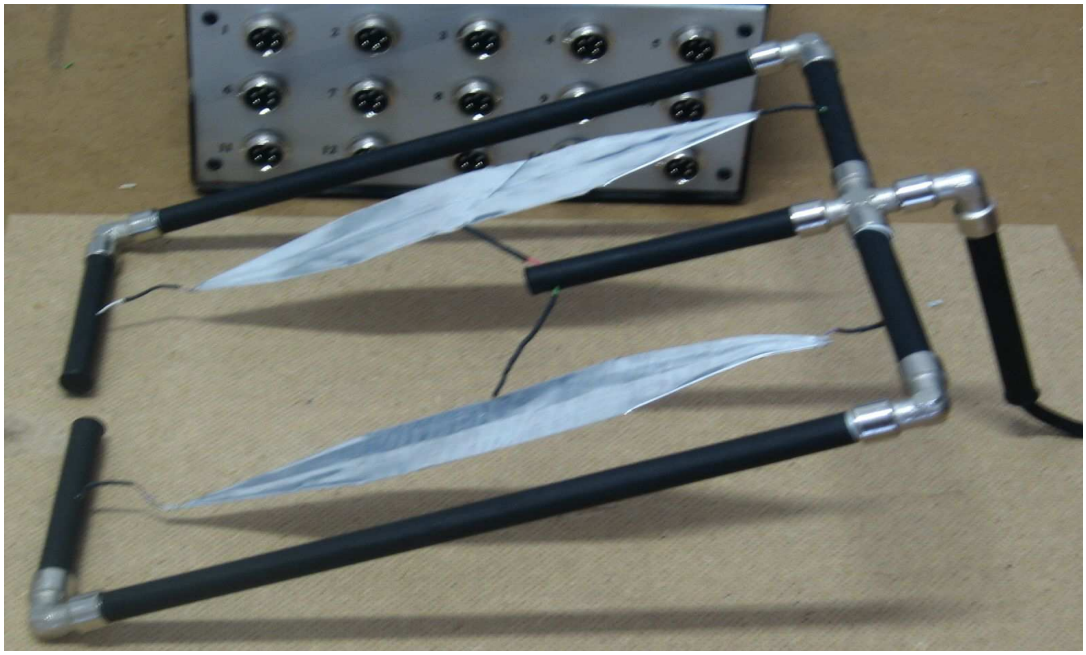

Leaf replica sensor for peach tree leaves

AVAILABLE JANUARY 2009

Reference

- BRENNER A.J., JARVIS P.G. 1995. A heated leaf replica technique for determination of leaf boundary layer conductance in the field. Agricultural and Forest Meteorology 72: 261 – 275;
- MOTISI A., MARRA F.P., PERNICE F., CARUSO T. 2007. Ecophysiological Characterization of the Canopy of Peach (P. persica L. Batsch) in Two Planting Systems. Proceeding of the 8th International Symposium on Canopy, Rootstocks and Environmental Physiology in Orchard Systems – Acta Hort 732: 579 – 585;
- PARK S. NOBEL. 2005. Physicochemical and environmental plant physiology – third edition – Chapter 7 (temperature and energy budgets);
- PERNICE F., MARRA F.P., MOTISI A., CARUSO T. 2003. Studio dell'effetto della forma di allevamento sulla conduttanza dello strato limite di foglie di pesco mediante foglie-replica. Proceedings of 4th National congress on peach culture of south Italy), 11 -12 September, Campobello di Licata and Agrigento (Italy) – pag 117-120.